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Case report

# Potential dangers of accelerant use in arson

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ABSTRACT

Accelerant-enhanced combustion often characterizes a fire that has been deliberately set to disguise a murder scene or to destroy property for insurance purposes. The intensity and rapidity of spread of fires where accelerants have been used are often underestimated by perpetrators who may sustain heat-related injuries. The case of a 49-year-old male who was using gasoline (petrol) as an accelerant is reported to demonstrate another danger of this type of activity. After ignition, an explosion occurred that destroyed the building and caused the death of the victim who was crushed beneath a rear wall of the commercial premises. Gasoline vapour/air mixtures are extremely volatile and may cause significant explosions if exposed to flame. Given the potential danger of explosion, arsonists using accelerants do so at significant risk to themselves and to others in the vicinity.


## 1. Introduction

The discovery of a body at the scene of a fire or explosion raises a number of issues for police investigators and pathologists. These concern predominantly the mechanism and manner of death, and among the most important roles of the autopsy are to establish whether of not the victim was alive at the time of the event, whether there was any evidence of pre-existing injury or natural disease, and what was the most likely cause of death. When arson is suspected the deceased may have been the victim of foul play and either have been killed by the fire, having been previously incapacitated in some way, or died before the fire, that was then used in an attempt to disguise the murder. A case is reported where gasoline was being used as an accelerant. Miscalculation of the explosive potential of gasoline vapour resulted in death of the perpetrator.

## 2. Case report

The body of a 49-year-old male was found lying on his left side buried beneath a masonry wall and rubble following an explosion at a commercial premises partly owned by the deceased (Fig. 1). The clothing of the deceased was torn and partially melted in areas. A cigarette lighter was present in his right hand (Fig. 2). A motor vehicle registered to the deceased was parked in a laneway behind the premises, facing away from the building. The vehicle was unlocked and the keys were in the ignition. A search of the scene revealed two empty 20 L plastic fuel containers, one empty 10 L plastic fuel container and a full 5 L plastic fuel container inside the premises. Chemical analysis of the containers was positive for unleaded gasoline. The building had been significantly damaged by the explosion and subsequently required demolition. There had been only a small of associated fire.

At autopsy there were extensive superficial flash-type burns of the chest, abdomen, back and limbs with sparing of the head and neck, involving approximately 60% of the total body surface. The hair on the scalp and the eyebrows were singed. A right peri-orbital hematoma was present, along with patchy superficial abrasions and lacerations of the head and neck. There was a 93 mm laceration of the right parieto-temporal scalp overlying fractures of the skull vault and base of skull with patchy traumatic subarachnoid hemorrhage and minor contusions of the inferior right frontal lobe and the right and left medial temporal lobes. There were multiple superficial abrasions and lacerations of the trunk and limbs. The right hip was dislocated and there was a closed fracture of the distal right tibia and fibula. There were also multiple bilateral rib fractures with a flail chest and extensive left lung contusions. There was no soot present in the airways and no facial petechiae to suggest crush asphyxia.

Toxicological analyses of blood obtained at autopsy showed a carboxyhemoglobin saturation of 1%, with a low therapeutic

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**Fig. 1.** A view of the rear of the premises showing extensive damage from the gasoline explosion, with the body of the victim being found beneath the pile of rubble in the center field.

concentration of codeine and a subtherapeutic concentration of ibuprofen. Alcohol was not detected in the blood. Volatile organic compounds were not detected in the head space above either blood or lung samples. No natural disease that could have caused or contributed to the death was present. Analysis of the shoes worn by the deceased was positive for volatile organic compounds. Death was attributed to blunt cranial and chest trauma resulting from injuries sustained in the explosion.

## 3. Discussion

A variety of scenarios are possible when a body is found at the scene of a fire or an explosion. Fire-related deaths are the most common, and usually involve residents in a domestic dwelling succumbing to the effects of inhalation of products of combustion and burns in an accidental fire. Children and the elderly are particularly vulnerable.[1] When fires have been deliberately lit the motive can be to disguise a homicide by burning a body and destroying the associated scene. In our experience explosions usually occur in industrial settings and are either accidental or due to suicide. Explosion/ignition of gasoline vapour has also been reported in cases where gasoline was being heated over a flame to enhance vaporisation in recreational gasoline sniffing.[2]

**Fig. 2.** As the body of the victim was being excavated a cigarette lighter was found still clutched in the right hand.

The reported case illustrates an unusual scenario, that of an explosion occurring during the attempted setting of a fire in a small business. The finding of the victim's car in a nearby laneway, unlocked, with the keys in the ignition, and the victim with a cigarette lighter in his hand indicates that the intention was most likely to ignite the fire and quickly leave. Unfortunately the victim had used gasoline as an accelerant and had not understood the potential effects of igniting a large gasoline vapour cloud.

Gasoline is a common accelerant used to assist with the setting of fires in cases of arson. It consists of a complex mixture of over 100 hydrocarbons with a boiling point range from approximately 40 °C to 190°C.[3] The mixture contains both aliphatic (straight chain) and aromatic (ring structure) hydrocarbons such as pentane and toluene, respectively with a large amount of volatile compounds (boiling point <80 °C). Thus, gasoline is highly volatile, having a significant vapour pressure at ambient temperature. Combustion of fuels such as gasoline is an oxidation reaction, the source of oxygen for the combustion usually deriving from the surrounding air. Reactions are exothermic (heat evolving) and require a heat source such as a match or a spark for initiation. The exothermic nature of the reaction sustains the combustion until either the fuel or oxygen is consumed. When gasoline burns, therefore, it is not the liquid that is on fire, but the vapour/air mixture above the liquid surface. The flammable properties of the mixture are determined by the ratio of fuel vapour to air. When this mixture is within certain limits the speed of combustion is so rapid that an explosion may occur. Gasoline vapour/air explosions occur with gasoline concentrations between 1.1% and 6%.[4] When the concentration of gasoline is below the lower limit (lean mixture), no ignition results due to too little fuel. When it is above this limit (rich mixture), combustion rather than an explosion will occur until a point is reached where there is too much fuel for the available oxygen and combustion cannot be sustained.

Often arsonists will douse carpets, furniture, curtains and other furnishings with gasoline creating a large surface area that enhances fuel evaporation and the production of a flammable air/fuel atmosphere. Air currents and diffusion of vapour will aid the spread of the volatile atmosphere, and conditions conducive to an explosion may be rapidly established throughout a building. Fuel/air explosions involving gasoline can be extremely powerful causing severe structural damage to buildings. Typical features involve bowed walls and raised ceilings, and in many cases the explosion will cause structures to collapse, as in the reported case.

Underestimation of the intensity of fires generated by accelerants has been reported previously, with features such as singed eyelashes, eyebrows and hair, and burns being useful indicators of proximity to an intense fire in the investigation of arson.[5] The present case demonstrates an extreme situation with explosion of a gasoline vapour/air mixture resulting in demolition of the premises and death of the victim/perpetrator beneath the back wall of a building that had blown outwards.

The autopsy approach to such cases involves careful evaluation of the scene with particular attention being paid to the position of the victim, the presence of a container for accelerant, and the pattern of the fire. The autopsy examination requires exclusion of prior inflicted injury that may implicate another person in the death, documentation of injuries/burns and assessment of any underlying natural diseases that may have contributed to the terminal episode. Examination of clothing may reveal the odour of accelerant and formal analyses can be undertaken for hydrocarbons[6] as was done on the shoes of the deceased. Cherry-red colour of the skin and soot within the upper airway indicates inhalation of products of combustion, although their absence does not exclude death during the fire, as flash fires from accelerants may be

characterized by very low carbon monoxide levels.[7] Full toxicological assessment should be performed for alcohol and prescribed and illicit drugs, as these may have contributed to the behaviour of the victim or slowed reflexes resulting in entrapment. Blood carboxyhemoglobin and cyanide levels may prove exposure to smoke, and headspace analysis for volatiles may confirm exposure to accelerants.[8]

The reported case demonstrates a situation where an individual engaged in setting a fire underestimated the explosive nature of gasoline vapour/air mixture. The resultant explosion destroyed the building without causing any significant conflagration. Given the potential danger of explosion, arsonists using accelerants may do so at significant risk to themselves.

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